

## E791 Overview

- Collected data in 1991-92 run
- State-of-the-art DA system
- Over 20 billion events,  
50 Tb of data
- Many publications: see below!

# Publications

- 2 instrumentation publications
- 33 physics publications (refereed)
- More to come
- 8 have  $\geq 50$  citations
- 2 have  $\geq 99$  citations

## E791 Publications

February 21, 2003

Green color  $\Rightarrow$  50+ citations

Red color  $\Rightarrow$  99+ citations

## 1 Charm Production

E. M. Aitala *et al.* [Fermilab E791 Collaboration], "Differential cross-sections, charge production asymmetry, and spin density matrix elements for  $D^{*\pm}(2010)$  produced in 500-GeV/c  $\pi^-$ -nucleon interactions," PLB **539**, 218 (2002) [arXiv:hep-ex/0205099].

E. M. Aitala *et al.* [Fermilab E791 Collaboration], "Asymmetries in the production of  $\Lambda^0$ ,  $\Xi^-$ , and  $\Omega^-$  hyperons in 500-GeV/c  $\pi^-$ -nucleon interactions," PLB **496**, 9 (2000) [arXiv:hep-ex/0009016].

E. M. Aitala *et al.* [Fermilab E791 Collaboration], "Total Forward and Differential cross sections of Neutral D mesons produced in 500-GeV/c pi-nucleon interactions", PLB **462**, 225 (1999).

E. M. Aitala *et al.* [Fermilab E791 Collaboration], "Asymmetries in the production of  $\Lambda_c^+$  and  $\Lambda_c^-$  baryons in 500-GeV/c  $\pi^-$ -nucleon interactions," PLB **495**, 42 (2000) [arXiv:hep-ex/0008029].

E. M. Aitala *et al.* [Fermilab E791 Collaboration], "Correlations between D and anti-D mesons produced in 500-GeV/c pi-nucleon interactions", EPJC **4**, 1 (1999).

E. M. Aitala *et al.* [Fermilab E791 Collaboration], "Asymmetries between the Production of  $D_s^-$  and  $D_s^+$  Mesons from 500-GeV/c  $\pi^-$  Nucleon Interactions as Functions of  $x_F$  and  $p_T^2$ ", PLB **411**, 230 (1997).

E. M. Aitala *et al.* [Fermilab E791 Collaboration], "Observation of  $D - \pi$  Production Correlations in 500-GeV  $\pi^- N$  Interactions", PLB **403**, 185 (1997).

E. M. Aitala *et al.* [Fermilab E791 Collaboration], "Mass Splitting and Production of  $\Sigma_c^0$  and  $\Sigma_c^{++}$  Measured in 500-GeV  $\pi^- N$  Interactions", PLB **379**, 292 (1996).

E. M. Aitala *et al.* [Fermilab E791 Collaboration], "Asymmetries between the production of  $D^+$  and  $D^-$  mesons from 500-GeV/c  $\pi^-$ -nucleon interactions as a function of  $x_F$  and  $p_T^2$ ", PLB **371**, 157 (1996).

## 2 Resonant Analyses

E. M. Aitala *et al.* [Fermilab E791 Collaboration], "Dalitz plot analysis of the decay  $D^+ \rightarrow K^- \pi^+ \pi^+$  and study of the  $K\pi$  scalar amplitudes," PRL **89**, 121801 (2002) [arXiv:hep-ex/0204018].

E. M. Aitala *et al.* [Fermilab E791 Collaboration], "Experimental evidence for a light and broad scalar resonance in  $D^+ \rightarrow \pi^- \pi^+ \pi^+$  decay," PRL **86**, 770 (2001) [arXiv:hep-ex/0007028].

E. M. Aitala *et al.* [Fermilab E791 Collaboration], "Study of the  $D_s^+ \rightarrow \pi^- \pi^+ \pi^+$  decay and measurement of  $f_0$  masses and widths," PRL **86**, 765 (2001) [arXiv:hep-ex/0007027].

E. M. Aitala *et al.* [Fermilab E791 Collaboration], "Study of the decay  $D^0 \rightarrow K^- K^+ \pi^+$ ," PRD **64**, 112003 (2001) [arXiv:hep-ex/0105075].

E. M. Aitala *et al.* [Fermilab E791 Collaboration], "Multidimensional Resonance Analysis of  $\Lambda_c^+ \rightarrow p K^- \pi^+$ ," PLB **471**, 449 (2000).

E. M. Aitala *et al.* [Fermilab E791 Collaboration], "Study of the Decay  $D^0 \rightarrow K^- K^+ \pi^- \pi^+$ ," PLB **423**, 185 (1998).

### 3 New Physics: Rare and Forbidden Decays

E. M. Aitala *et al.* [Fermilab E791 Collaboration], "Search for rare and forbidden charm meson decays  $D^0 \rightarrow V l^+ l^-$  and  $h h l l$ ," PRL **86**, 3969 (2001) [arXiv:hep-ex/0011077].

E. M. Aitala *et al.* [Fermilab E791 Collaboration], "Search for Rare and Forbidden Dilepton Decays of the  $D^+$ ,  $D_s^+$ , and  $D^0$  Charmed Mesons", PLB **462**, 401 (1999).

E. M. Aitala *et al.* [Fermilab E791 Collaboration], "Search for the Flavor Changing Neutral Current Decays  $D^+ \rightarrow \pi^+ \mu^+ \mu^-$  and  $D^+ \rightarrow \pi^+ e^+ e^-$ ", PRL **76**, 364 (1996).

## 4 New Physics: New particles

E. M. Aitala *et al.* [Fermilab E791 Collaboration], “Search for the Pentaquark via the  $P^0(\bar{c}s) \rightarrow K^{*0}K^-p$  decay” PLB **448**, 303 (1999).

E. M. Aitala *et al.* [Fermilab E791 Collaboration], “Search for the Pentaquark via the  $P^0(\bar{c}s)$  Decay  $\rightarrow \phi\pi p$ ”, PRL **81**, 44 (1998).

## 5 Study of pions

E. M. Aitala *et al.* [Fermilab E791 Collaboration], “Observation of color transparency in diffractive dissociation of pions,” PRL **86**, 4773 (2001) [arXiv:hep-ex/0010044].

E. M. Aitala *et al.* [Fermilab E791 Collaboration], “Direct measurement of the pion valence quark momentum distribution, the pion light cone wave function squared,” PRL **86**, 4768 (2001) [arXiv:hep-ex/0010043].



## 6 Lifetimes, Mixing and CP violation

E. M. Aitala *et al.* [Fermilab E791 Collaboration], “Lifetimes and lifetime difference between  $D^0 \rightarrow KK$  and  $D^0 \rightarrow K\pi$ ”, PRL **83**, 32 (1999).

E. M. Aitala *et al.* [Fermilab E791 Collaboration], “Measurement of the  $D_s^+$  lifetime”, PLB **445**, 449 (1999).

E. M. Aitala *et al.* [Fermilab E791 Collaboration], “Branching Fractions for  $D^0 \rightarrow K^+K^-$  and  $D^0 \rightarrow \pi^+\pi^-$ , and a Search for CP Violation in  $D^0$  Decays”, PLB **421**, 405 (1998).

E. M. Aitala *et al.* [Fermilab E791 Collaboration], “A Search for  $D^0 - \bar{D}^0$  mixing and Doubly Cabibbo Suppressed Decays of the  $D^0$  in Hadronic Final States”, PRD **57**, 13 (1998).

E. M. Aitala *et al.* [Fermilab E791 Collaboration], “Search for CP Violation in Charged  $D$  Meson Decays”, PLB **403**, 377 (1997).

E. M. Aitala *et al.* [Fermilab E791 Collaboration], “Search for  $D^0 - \bar{D}^0$  mixing in Semileptonic Decay Modes”, PRL **77**, 2384 (1996).

## 7 Charm Decay Physics

E. M. Aitala *et al.* [Fermilab E791 Collaboration], “Measurement of the form-factor ratios for  $D_s^+ \rightarrow \phi l^+ \nu_l$ ” PLB **450**, 294 (1999).

E. M. Aitala *et al.* [Fermilab E791 Collaboration], “Measurement of the form-factor ratios for  $D^+ \rightarrow \overline{K}^{*0} l^+ \nu_l$ ”, PLB **440**, 435 (1998).

E. M. Aitala *et al.* [Fermilab E791 Collaboration], “Measurement of the Form-Factor Ratios for  $D^+ \rightarrow \overline{K}^{*0} e^+ \nu_e$ ”, PRL **80**, 1393 (1998).

E. M. Aitala *et al.* [Fermilab E791 Collaboration], “Doubly Cabibbo Suppressed Decay  $D^+ \rightarrow K^+ \pi^+ \pi^-$ ” PLB **404**, 187 (1997).

E. M. Aitala *et al.* [Fermilab E791 Collaboration], “Measurement of the Branching Ratio  $B(D^+ \rightarrow \rho^0 l^+ \nu_l) / B(D^+ \rightarrow \overline{K}^{*0} l^+ \nu_l)$ ”, PLB **397**, 325 (1997).

# List of publications, citations

## Fermilab Charm Hadroproduction Experiment E791 Publications

First Author	Subject	Journal	Spires Cites
1. Aitala	FCNC Search, $D^+ \rightarrow \pi^+ \mu^+ \mu^-$ and $\pi^+ e^+ e^-$	PRL <b>76</b> (1996) 364	69
2. Aitala	Production Asymmetry of $D^+$ and $D^-$	PLB <b>371</b> (1996) 157	131
3. Aitala	Mass Splitting, Production of $\Sigma_c^0$ and $\Sigma_c^{++}$	PLB <b>379</b> (1996) 292	21
4. Aitala	Semileptonic $D^0$ - $\bar{D}^0$ Mixing Search	PRL <b>77</b> (1996) 2384	84
5. Aitala	$BR(D^+ \rightarrow \rho^0 \ell^+ \nu_\ell) / BR(D^+ \rightarrow \bar{K}^{*0} \ell^+ \nu_\ell)$	PLB <b>397</b> (1997) 325	21
6. Aitala	D- $\pi$ Production Correlations	PLB <b>403</b> (1997) 185	19
7. Aitala	CP Violation Search in Charged D Decays	PLB <b>403</b> (1997) 377	40
8. Aitala	Doubly Cabibbo-Suppressed $D^+ \rightarrow K^+ \pi^- \pi^+$	PLB <b>404</b> (1997) 187	19
9. Aitala	Production Asymmetry of $D_s^+$ and $D_s^-$	PLB <b>411</b> (1997) 230	47
10. Aitala	$D^0$ - $\bar{D}^0$ Mixing Search in Hadronic States	PRD <b>57</b> (1998) 13	80
11. Aitala	Form-Factor Ratios for $D^+ \rightarrow \bar{K}^{*0} e^+ \nu_e$	PRL <b>80</b> (1998) 1393	37
12. Aitala	$BR(D^0 \rightarrow K^+ K^-$ and $\pi^+ \pi^-)$ and CP	PLB <b>421</b> (1998) 405	49
13. Aitala	Study of $D^0 \rightarrow K^- K^+ \pi^- \pi^+$	PLB <b>423</b> (1998) 185	8
14. Aitala	Pentaquark Search via $P_\pi^0 \rightarrow \phi \pi p$	PRL <b>81</b> (1998) 44	16
15. Aitala	Form-Factor Ratios for $D^+ \rightarrow \bar{K}^{*0} \ell^+ \nu_\ell$	PLB <b>440</b> (1998) 435	22
16. Aitala	$D_s$ Lifetime Measurement	PLB <b>445</b> (1999) 449	26
17. Aitala	Pentaquark Search via $P_\pi^0 \rightarrow K^{*0} K^- p$	PLB <b>448</b> (1999) 303	3
18. Aitala	Form-Factor Ratios for $D_s^+ \rightarrow \phi \ell^+ \nu_\ell$	PLB <b>450</b> (1999) 294	12
19. Aitala	Lifetime Difference Limit in the $D^0$ System	PRL <b>83</b> (1999) 32	77
20. Aitala	Correlations Between D and $\bar{D}$ Mesons	EPJdirect <b>C1</b> (1999) 4	66
21. Aitala	Total and Differential $D^0$ Cross Sections	PLB <b>462</b> (1999) 225	17
22. Aitala	Search for Rare Decays of $D^+$ , $D_s^+$ , and $D^0$	PLB <b>462</b> (1999) 401	37
23. Aitala	Multidimensional Resonance $\Lambda_c^+ \rightarrow p K^+ \pi^-$	PLB <b>471</b> (2000) 449	12
24. Aitala	Production Asymmetry of $\Lambda_c^+$ and $\Lambda_c^-$	PLB <b>495</b> (2000) 42	15
25. Aitala	Production Asymmetry of $\Lambda^0$ , $\Xi^-$ , and $\Omega^-$	PLB <b>496</b> (2000) 9	10
26. Aitala	$D_s^+ \rightarrow \pi^+ \pi^- \pi^+$ Decay and the $f_0$	PRL <b>86</b> (2001) 765	57
27. Aitala	Scalar Resonance in $D^+ \rightarrow \pi^+ \pi^- \pi^+$	PRL <b>86</b> (2001) 770	99
28. Aitala	Search for Rare $D^0 \rightarrow V \ell^+ \ell^-$ and $h h \ell \ell$	PRL <b>86</b> (2001) 3969	17
29. Aitala	Pion Light-Cone Wave Function	PRL <b>86</b> (2001) 4768	46
29. Aitala	Color-Transparency in Pion Dissociation	PRL <b>86</b> (2001) 4773	37
31. Aitala	Study of the Decay $D^0 \rightarrow K^- K^- K^+ \pi^+$	PRD <b>64</b> (2001) 112003	2
32. Aitala	Scalar Resonance in $D^+ \rightarrow K^- \pi^+ \pi^+$	PRL <b>89</b> (2002) 121801	19
33. Aitala	$D^{*\pm}$ Differential Cross Sections, Spin...	PLB <b>539</b> (2002) 218	0
1. Amato	E791 Parallel Architecture DA System	NIM <b>A324</b> (1993) 535	120
2. Bracker	Multiprocessor Event-Parallel Computing	IEEE NS <b>43</b> (1996)2457	53

# Types of publications

- Instrumentation publications: 2
- Rare and Forbidden Decays: 3
- Lifetimes, Mixing and CP violation: 6
- New particle searches: 2
- Production of charm: 9
- Pion physics: 2
- Resonant analyses of decays: 7
- Other Charm Decay physics: 4

# Instrumentation

- State of the art, high-volume DA system was pioneered by E791
- Exabyte tape drives for 8mm tapes used heavily and debugged, introduced to HEP
- Created DA components such as the DYC (Summers, Bracker, Hansen et al.) used by other experiments now.

# Unique physics

- Search for pentaquarks (a first)
- Search for a lifetime difference in  $KK/K\pi$
- $\Lambda_c$  multi-dimensional resonant analysis
- Evidence for and analysis of scalar mesons:
  - Masses and widths of scalars
  - Masses and widths of other resonances
- Spin Density of hadroproduced  $D^*$
- Many unique results came late  
=> Dig deep and persevere!

# Highly cited papers

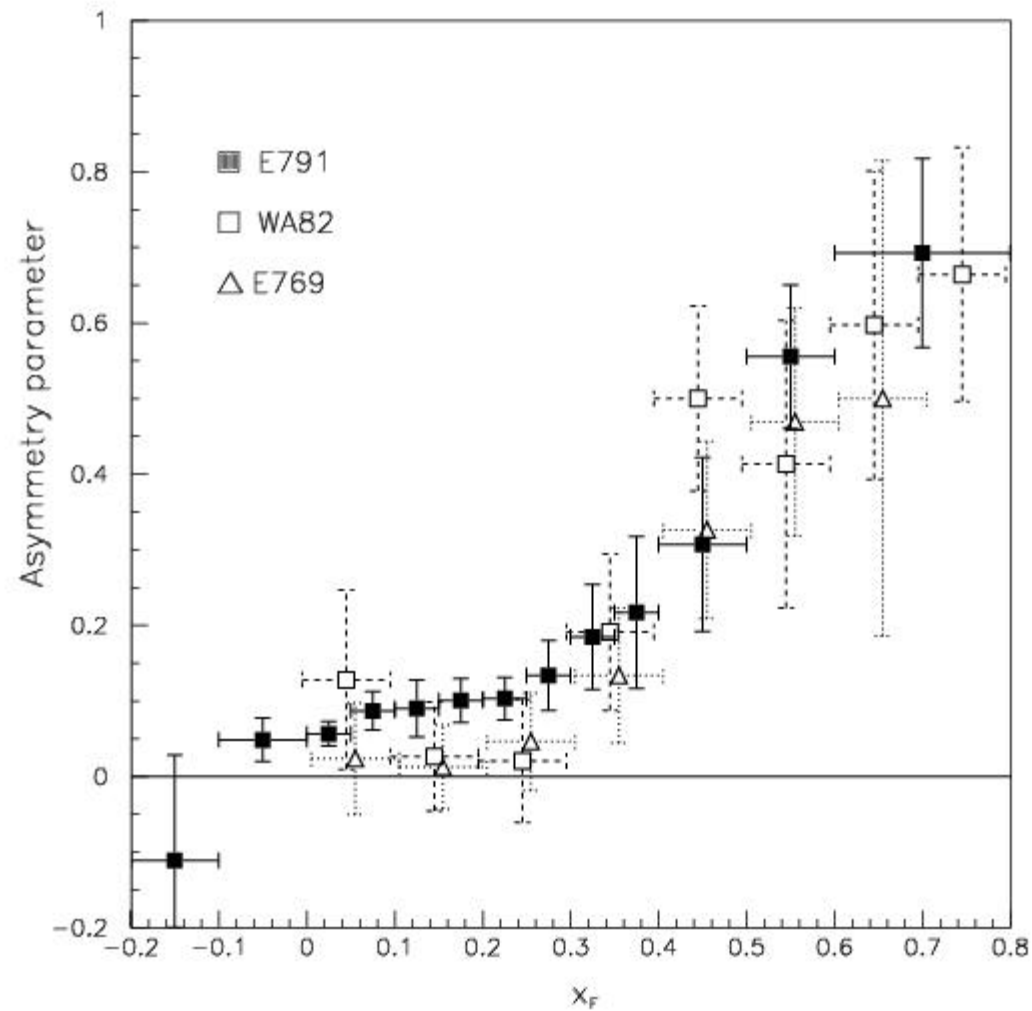
- $D^+/D^-$  production asymmetry (131)
- Scalar resonance in  $D^+ \rightarrow \pi\pi\pi$  decays (99)
- Semileptonic mixing search (84)
- Hadronic mixing search (80)
- Lifetime difference in  $D^0$  system (77)
- First paper: FCNC search (69)
- D-Dbar correlations (66)
- Resonances in  $D_s^+ \rightarrow \pi\pi\pi$  decays (57)
- Several papers have  $> 40$  citations
- Instrumentation papers have 120, 53 citations!

# Charm Production Physics (9 publications)

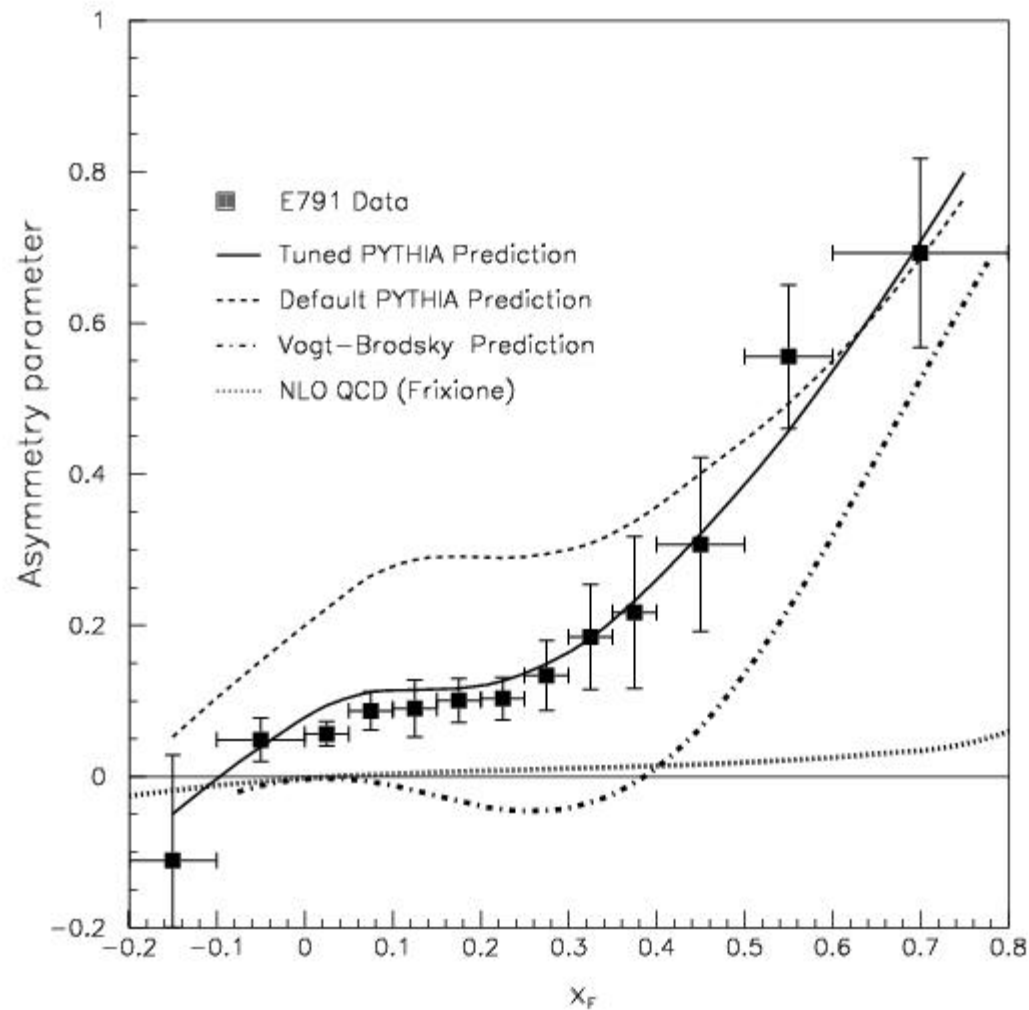
- Largest sample of hadronically produced charm
- Measured total and differential cross-sections, production asymmetries, polarization effects for a variety of particles.
- Studied  $D\bar{D}$  and  $D\pi$  correlations.
- Compared results to theoretical predictions.



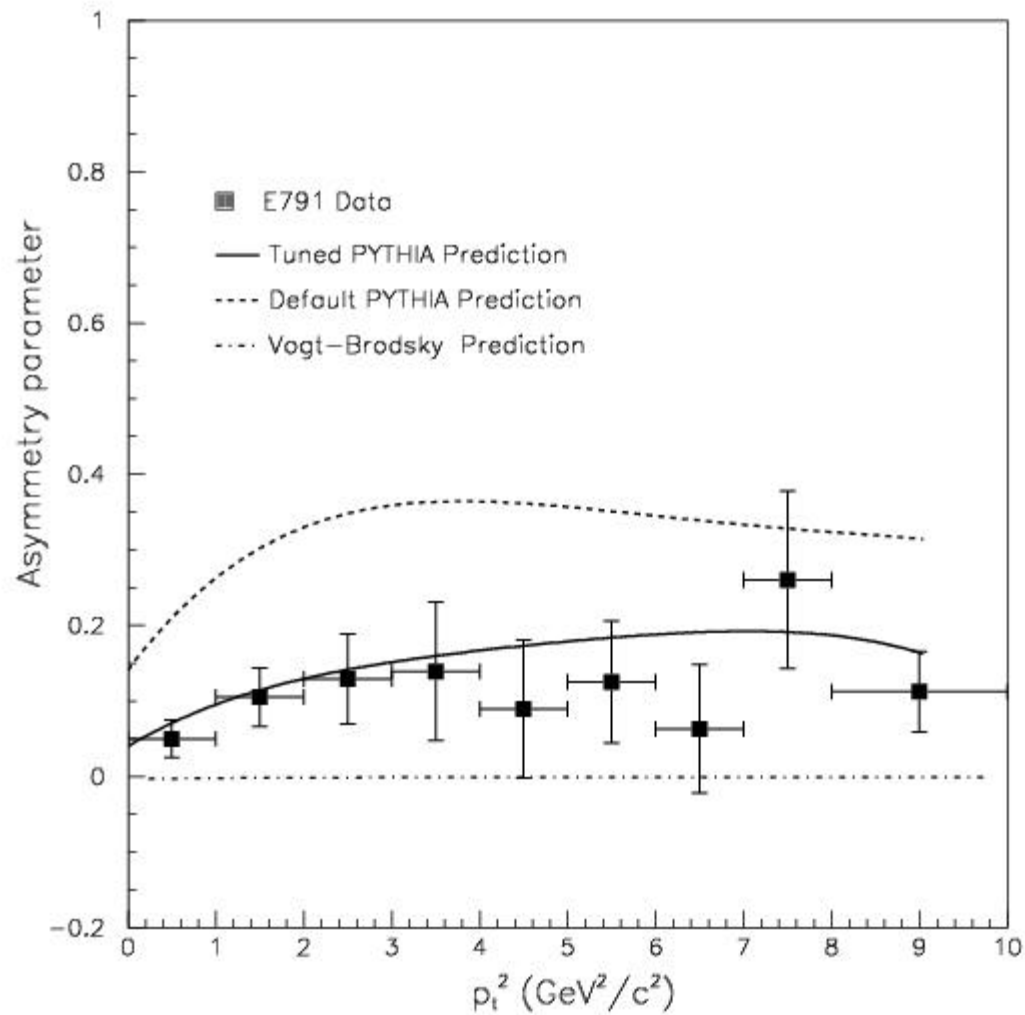
# $D^- / D^+$ asymmetry vs. $x_F$



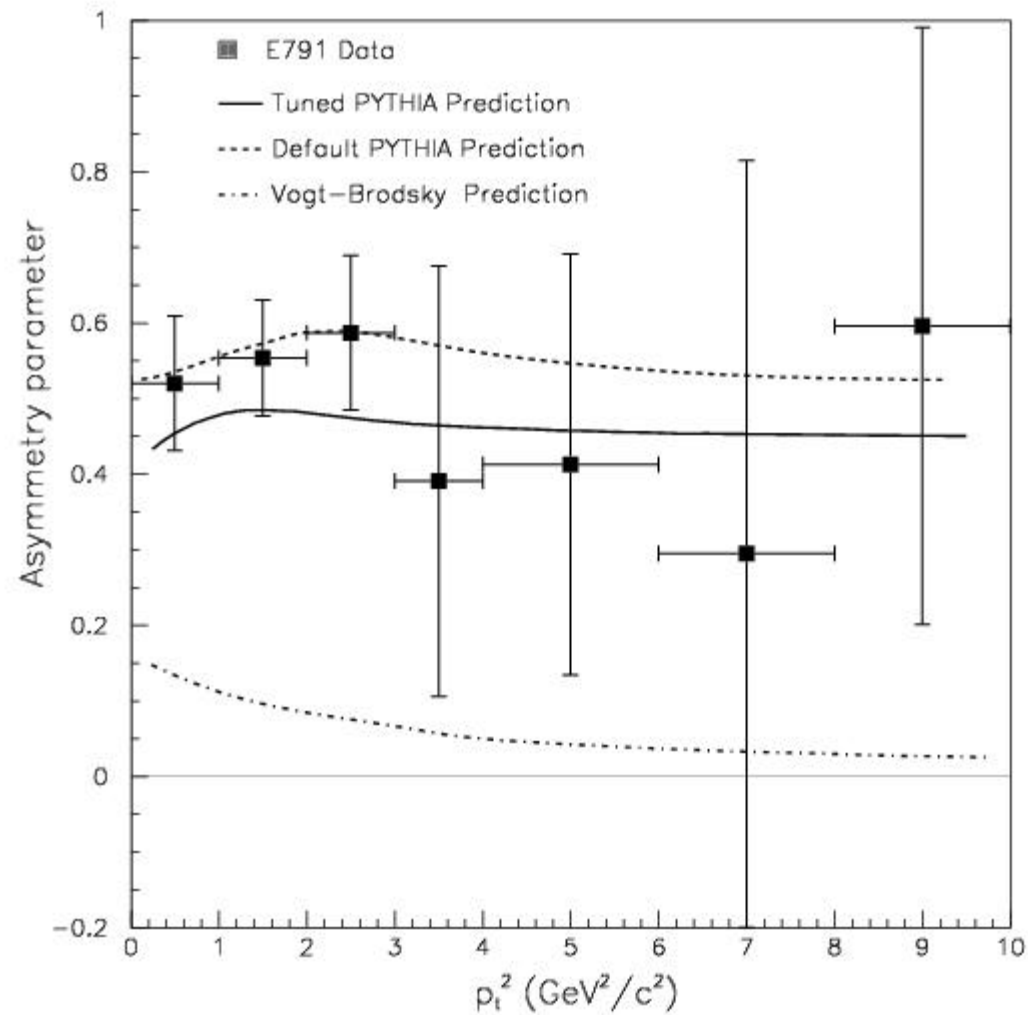
# Comparison to Predictions



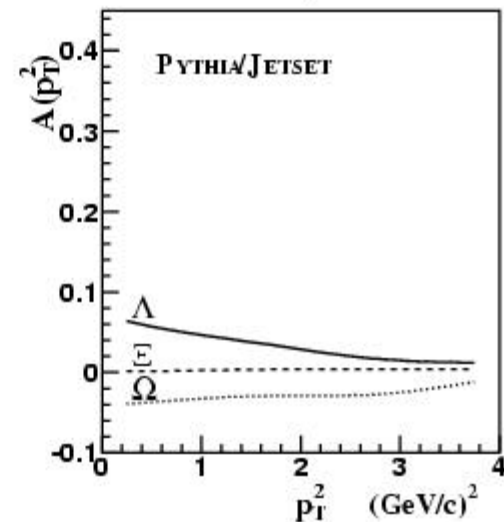
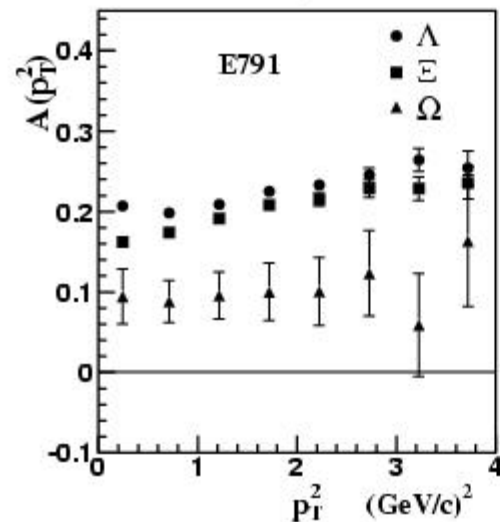
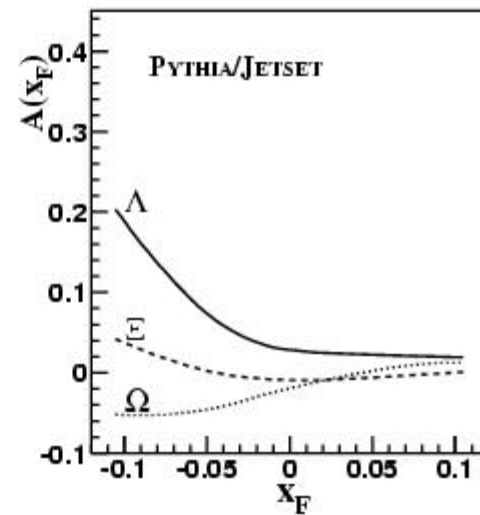
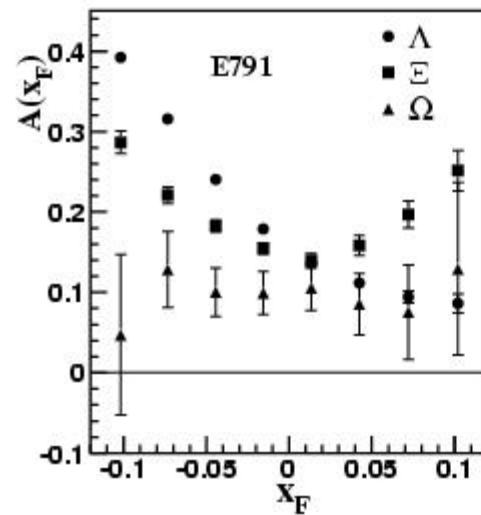
# Comparison vs. $p_T^2$



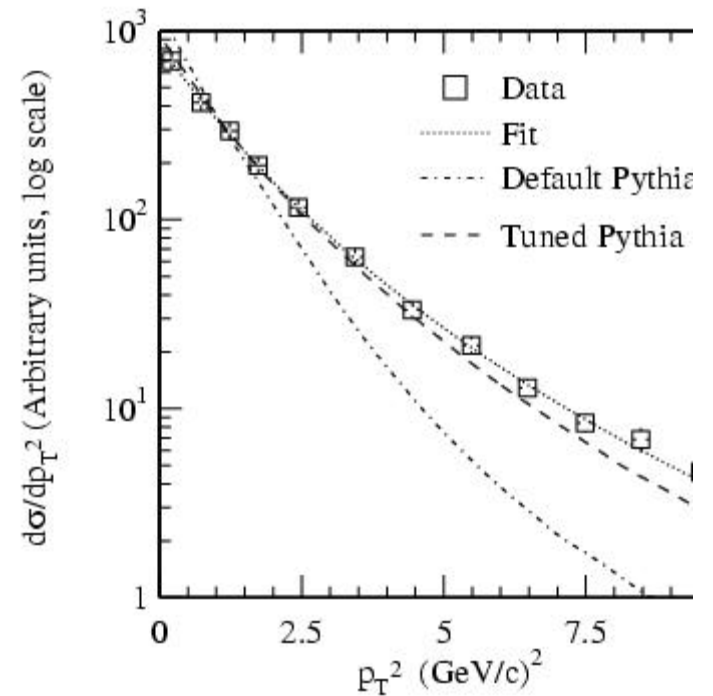
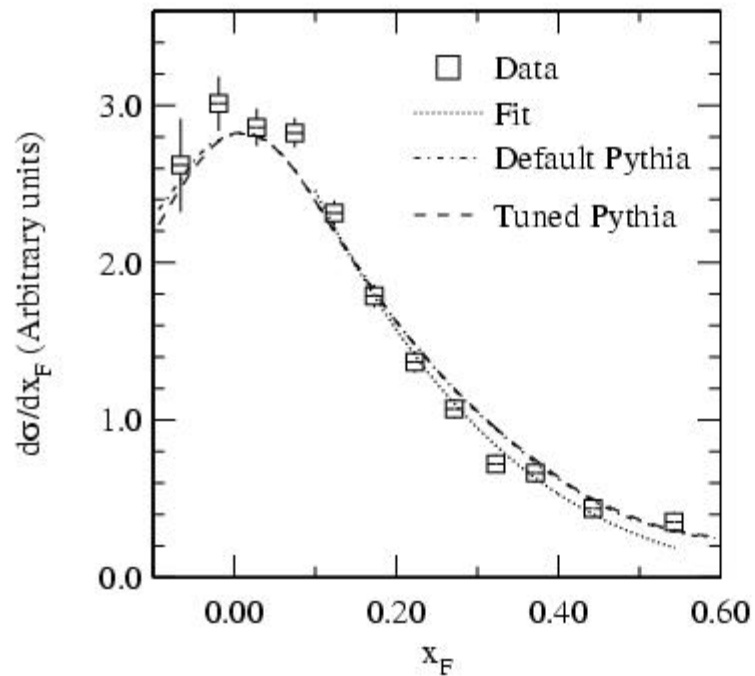
# Another prediction



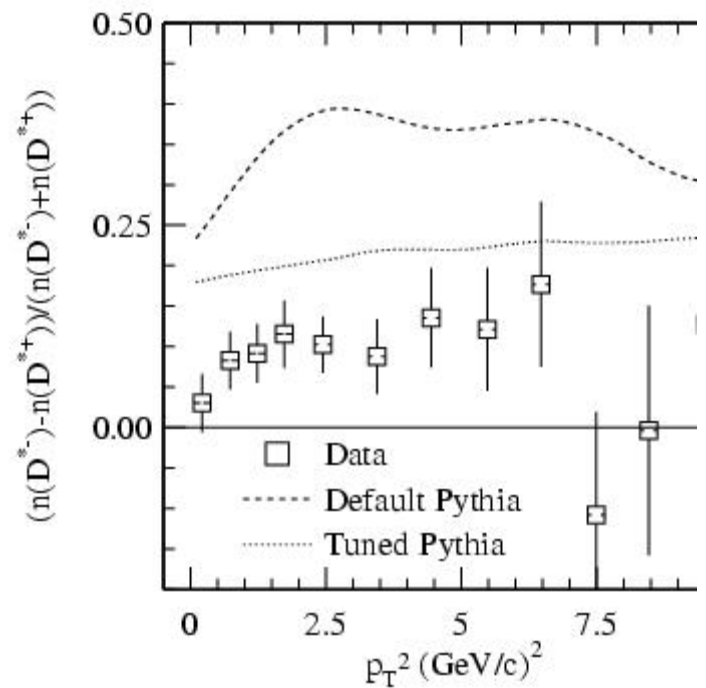
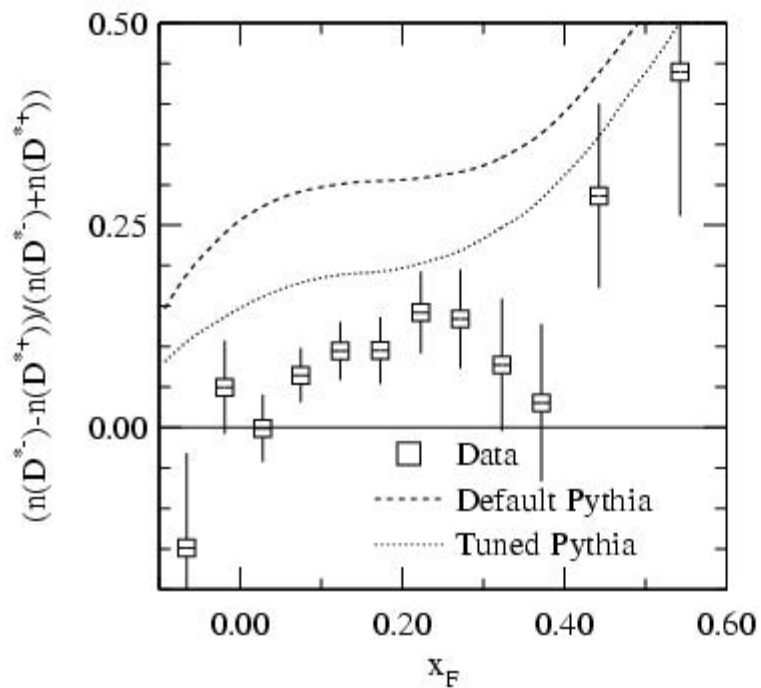
# Hyperon production asymmetries



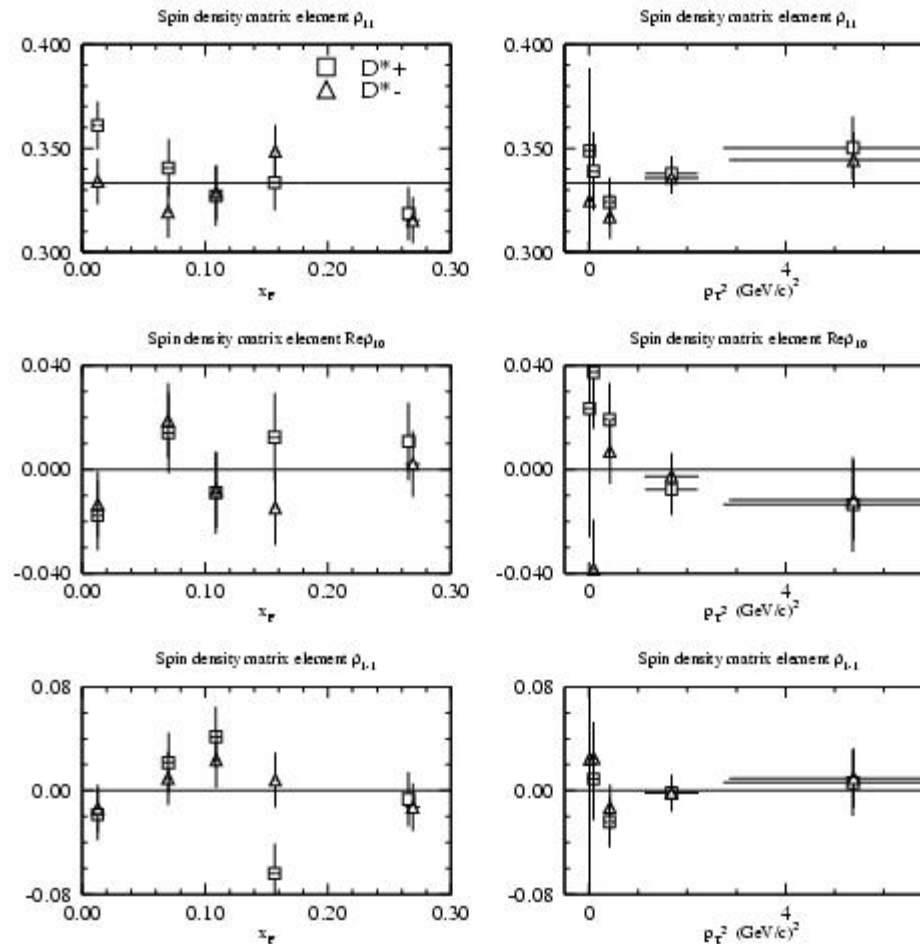
# $D^{*+}$ production vs. $x_F$ , $p_T^2$



# D\* asymmetry vs. $x_F$ , $p_T^2$



# D\* spin density matrix elements





# Resonant Analysis of Charm Decays (7 publications)

- Scalar resonance in  $D^+ \rightarrow K\pi\pi$  decays
- Scalar resonance in  $D^+ \rightarrow \pi\pi\pi$  decays
- Scalar resonance in  $D_s^+ \rightarrow \pi\pi\pi$  decays
- New determination of  $f_0(980)$  and other parameters in  $D_s^+ \rightarrow \pi\pi\pi$  decays
- New 5-dimensional  $\Lambda_c \rightarrow pK\pi$  resonant analysis and polarization measurement.

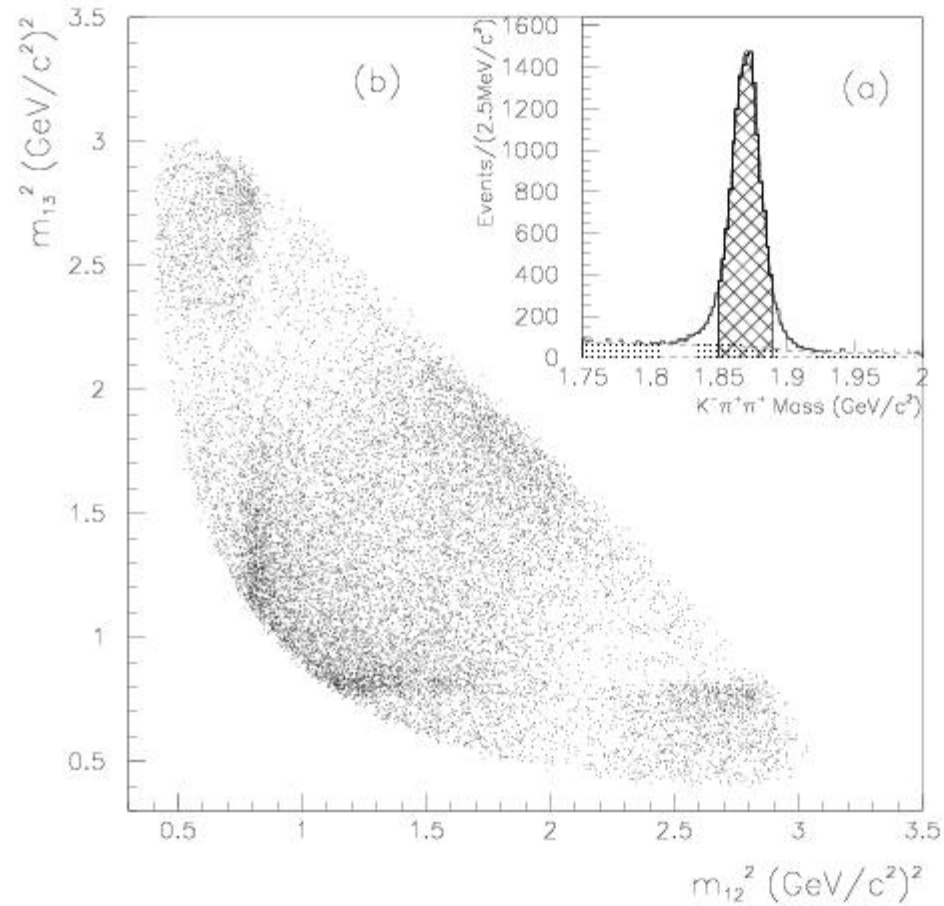
# Scalar resonance parameters

- $K^*_0(1430)$ :
  - $M = 1459 \pm 7 \pm 6 \text{ MeV}$   
 $\Gamma = 175 \pm 12 \pm 12 \text{ MeV}$
- Sigma:
  - $M = 478 \pm 24 \pm 17 \text{ MeV}$   
 $\Gamma = 324 \pm 41 \pm 21 \text{ MeV}$
- Kappa:
  - $M = 797 \pm 19 \pm 42 \text{ MeV}$   
 $\Gamma = 410 \pm 43 \pm 85 \text{ MeV}$
- Also, determined  $f_0(980)$  parameters

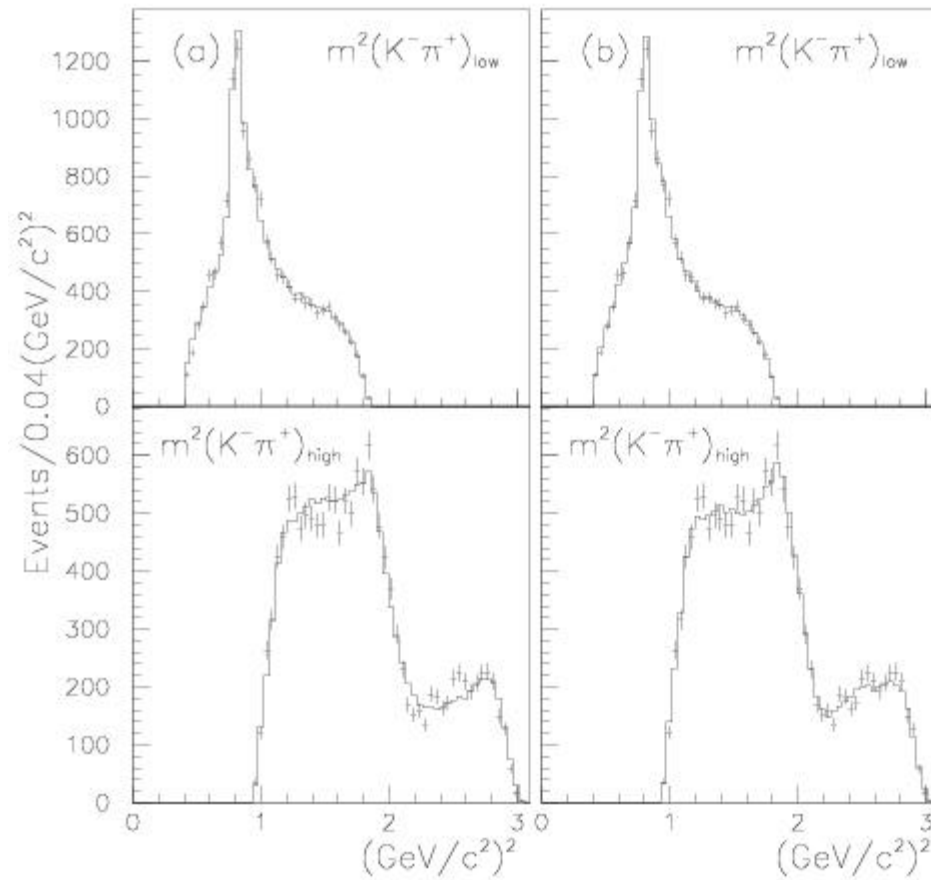
# Fits improve with addition of scalars!

- Classic  $D^+ \rightarrow K\pi\pi$  Dalitz plot fit has poor  $\chi^2$  (2.7 per DOF)
- Inclusion of a scalar improves this to 0.73 per DOF (95% probability)
- For the  $D^+ \rightarrow \pi\pi\pi$  decays Dalitz plot, the probability improves from 0.001% to 76% by inclusion of a scalar.

# $K^-\pi^+\pi^+$ Dalitz plot



# Fit without / with a scalar



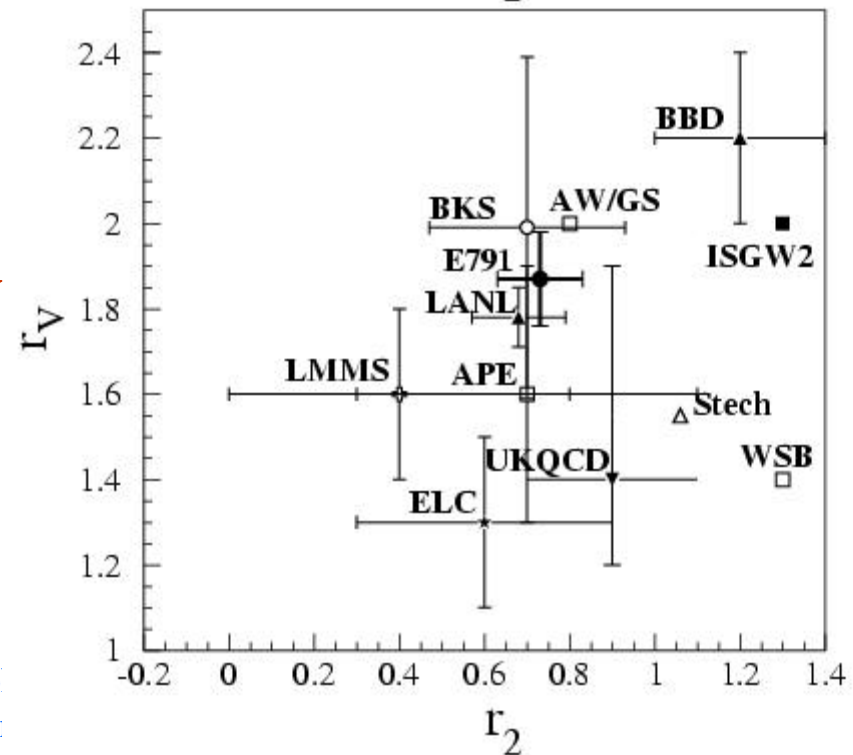
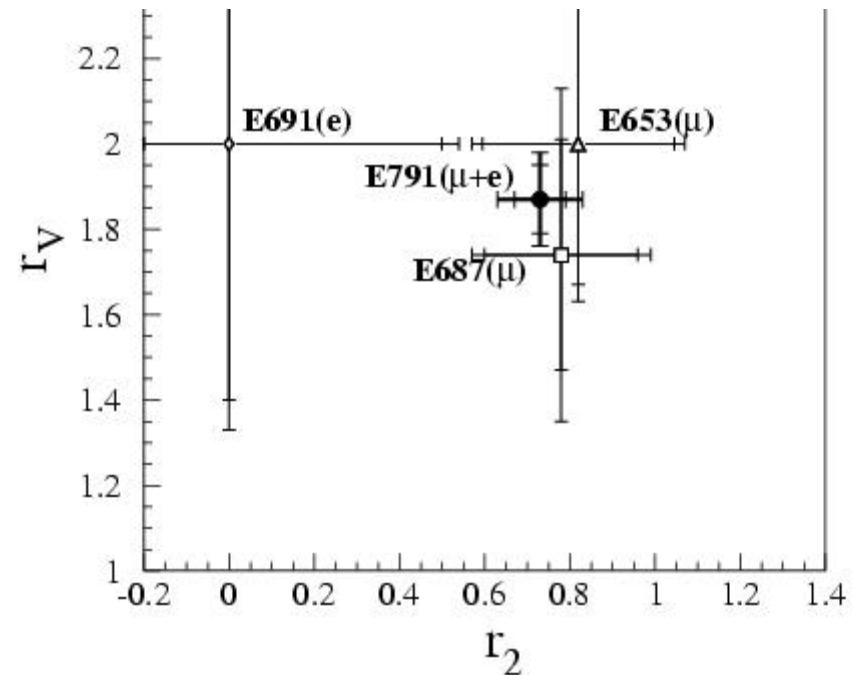
# Partial Wave analysis

- Analyses in progress by two groups
- Sum of s-wave amplitudes: one can plot the magnitude and phase as a function of mass.
- This can be
  - Compared to existing scattering data
  - Fit directly in mass slices [compares well to sum of NR, scalar and  $K^*_0(1430)$ ]

# Semileptonic Charm Decay Physics (4 publications)

- Better precision than previous experiments on form factor analyses.
- Better precision on branching ratios
- Studied
  - $D^+ \rightarrow K^* e \nu$  decays
  - $D^+ \rightarrow K^* \mu \nu$  decays
  - $D_s^+ \rightarrow \phi l \nu$  decays

# E791 Form Factor measurements compared to experiment, theory

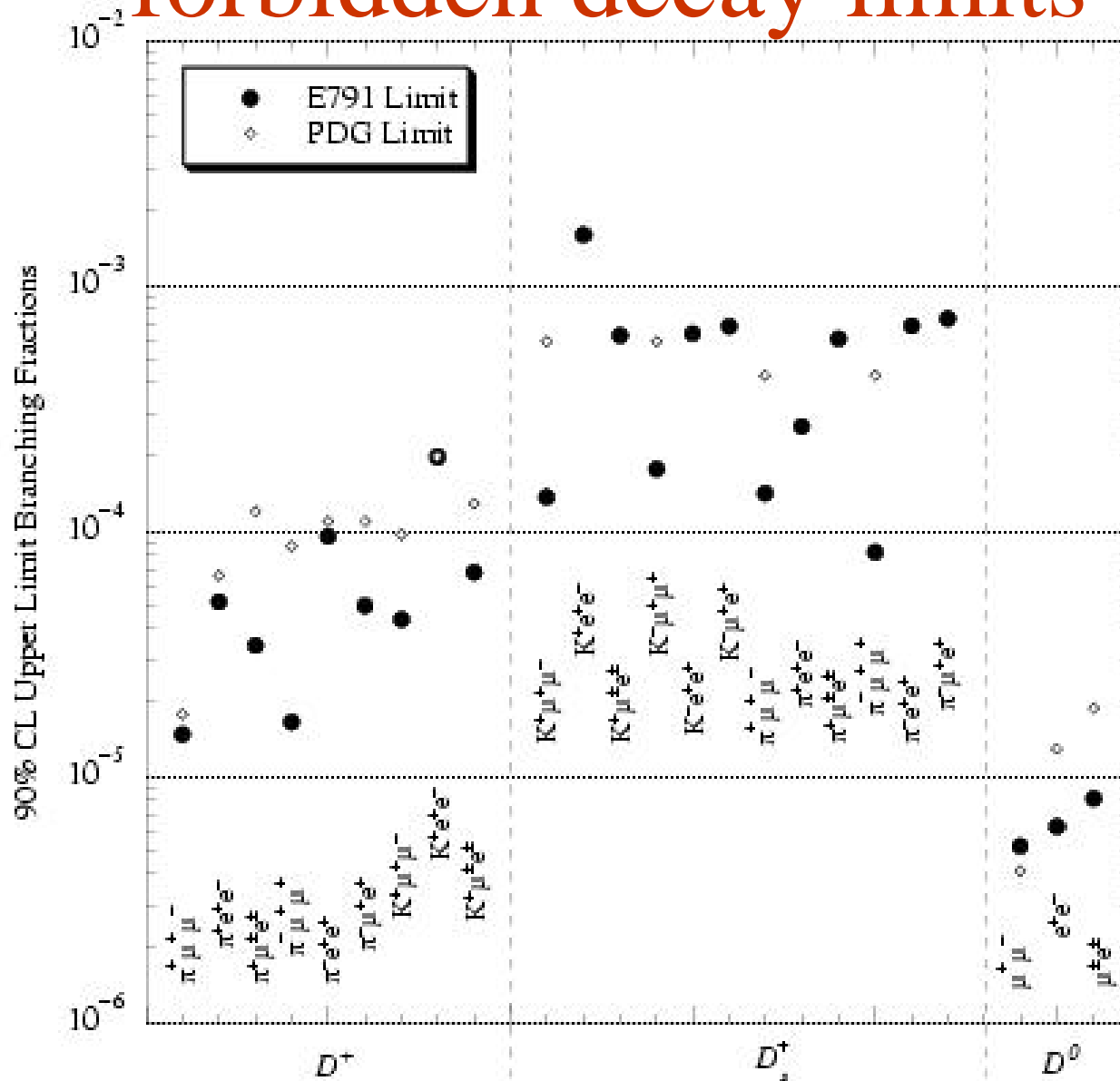




# Rare and Forbidden Decay Searches (3 publications)

- Better limits on dilepton ( $ll$ ) decays, as well as  $Vll$  and  $hhll$  decays
- Several limits improved, many by an order of magnitude or more
- 18 new modes studied

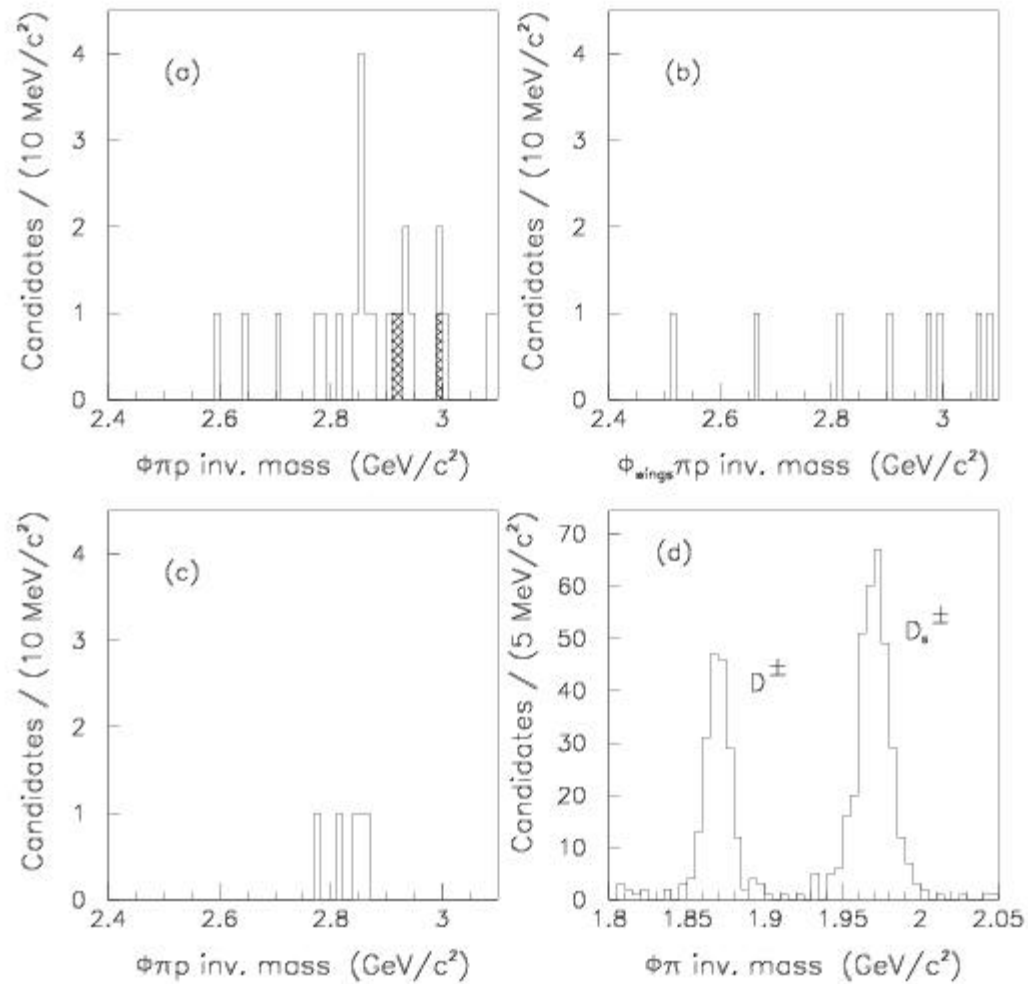
# Comparison of some rare / forbidden decay limits



# Searches for New Particles (2 publications)

- Jaffe predicted the H dibaryon; Lipkin and Gignoux *et al.* predicted the Pentaquark.
- Pentaquark, a  $\bar{c}s u u d$  state, searched for in  $\phi\pi p$  and  $K^{*0}K^-p$  modes.
- Upper limit close to interesting level
- Unpublished search for doubly charmed baryon was negative

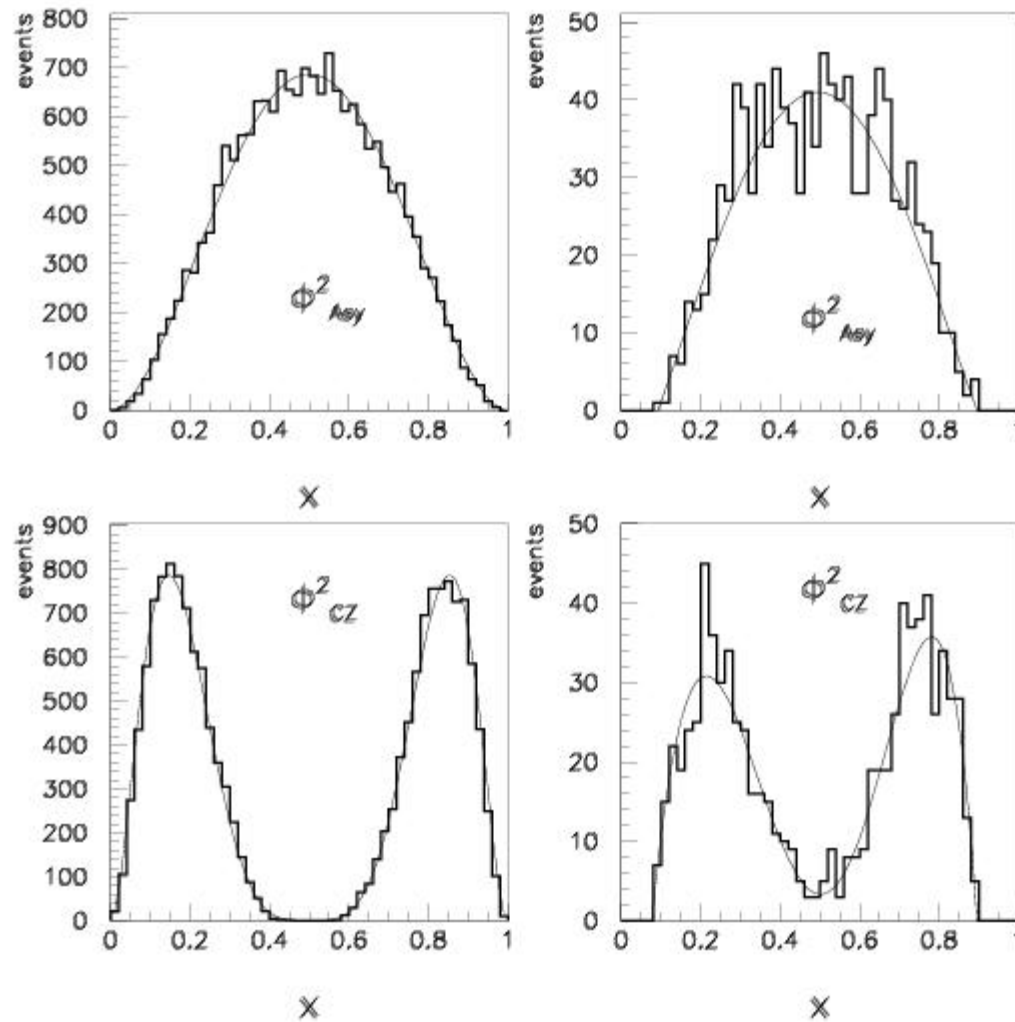
# Pentaquark search



# Physics of pions (2 publications)

- Studied diffractive dissociation of pions into two jets.
- Measured valence quark wavefunction of the pion
- Asymptotic wavefunction fits better than Chernyak-Zhitnitsky wavefunction (low- $Q^2$  correction based on QCD sum rules).
- A-dependence has  $\alpha = 1.6$ , in agreement with color-transparency models.

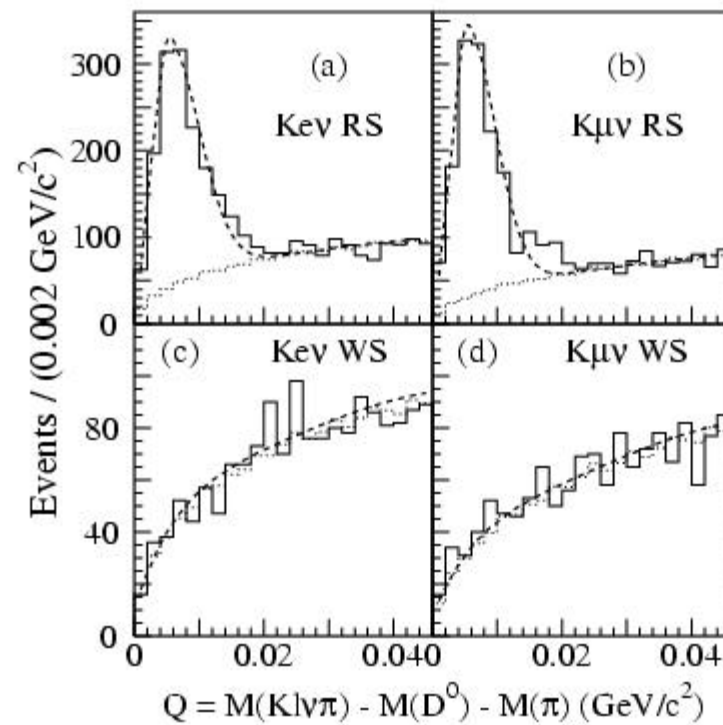
# Asymptotic and CZ pion wavefunctions



# Charm Lifetimes, Mixing and CP violation (6 publications)

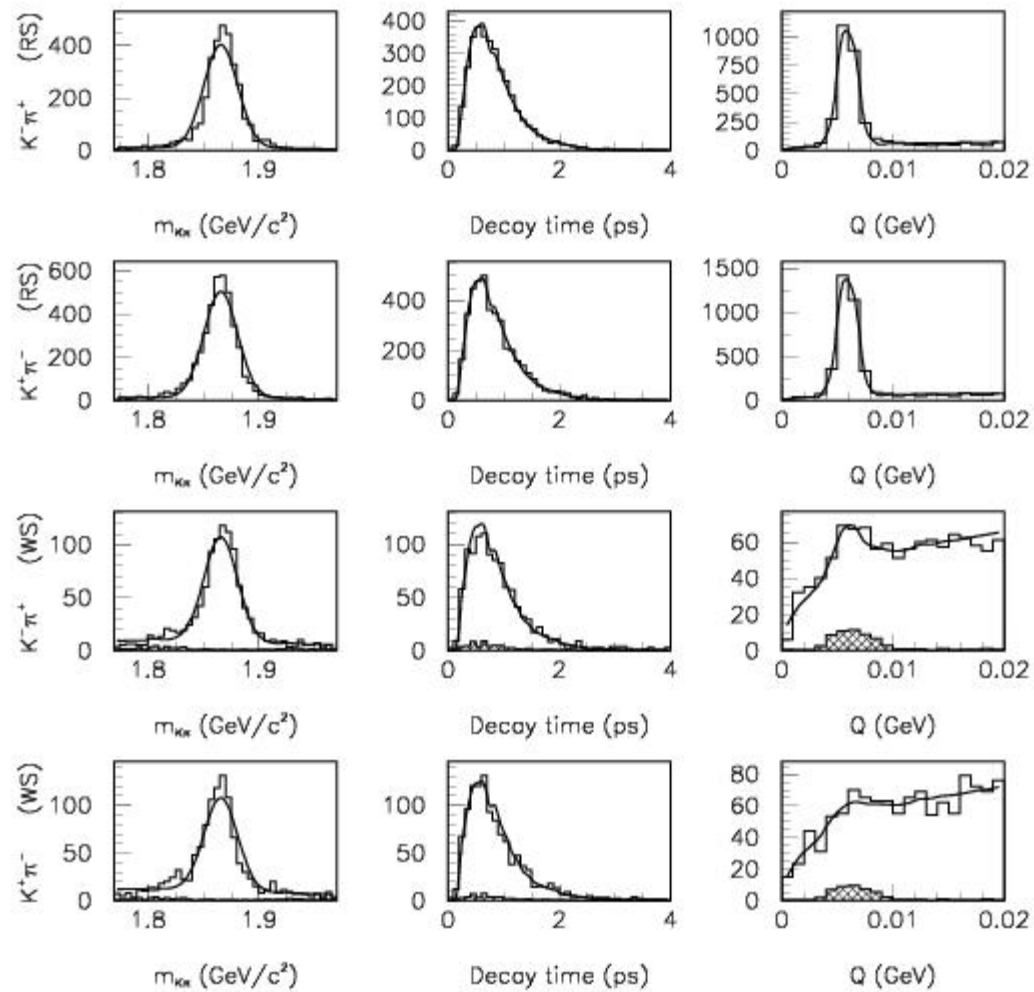
- First limit on mixing from reconstructed semileptonic decays
- Hadronic mixing studied with a variety of CP violation assumptions
- Precise measurement of the  $D^0$ - $D_s$  lifetime difference: definitively showing a difference.
- First direct measurement of mixing parameter  $y$  from lifetime difference in  $D^0$  system.
- New results on direct CP violation in charged and neutral D meson decays.

# Semileptonic mixing

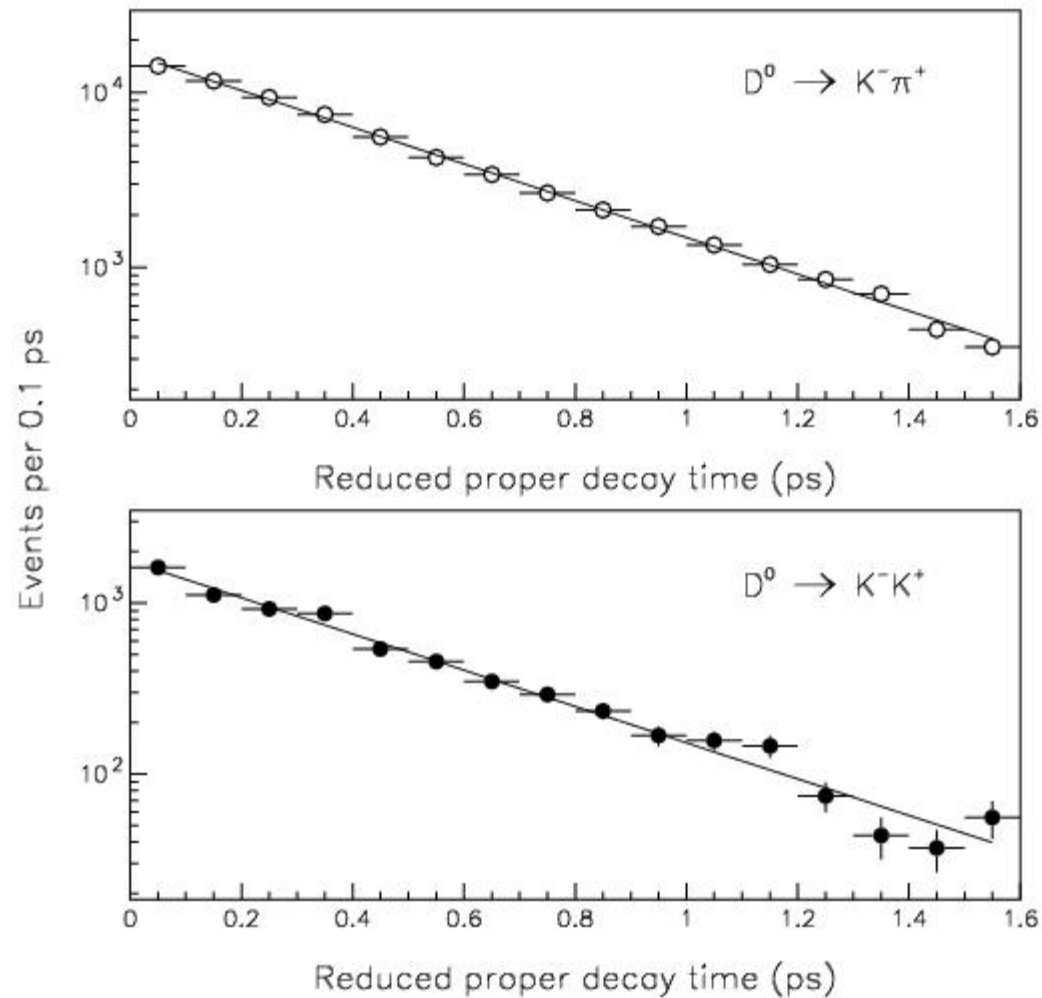




# Hadronic mixing, $K\pi$ channel



# $D^0$ lifetime difference



# Work in progress

- Partial Wave Analysis by two groups
- Ratio of  $D^0$  BRs to  $K\pi\pi\pi / K\pi$
- $\Xi^*$  mass, width, production  
(schedule depends on senior's graduation)
- Other production studies still possible:
  - hyperon polarization
  - Ratios and cross-sections vs  $x_F$ ,  $p_T^2$  of  $D^0$ ,  $D^+$ ,  $D_s$  and  $\Lambda_c$ .  
(This is a unique capability of E791 and requires work, support of and oversight by Fermilab staff and others.)

# Xi\* Studies in progress

Milind Purohit, Univ. of South  
Carolina, Feb 2003

# Master's and Ph.D.'s already awarded

- 23 Ph.D.'s and 7 Master's degrees awarded so far.

# Student Theses

## Fermilab Charm Hadroproduction Experiment E791 Theses

Author	Subject	Degree	University	Year
1. P. Gagnon	Form-Factor Ratios for $D^+ \rightarrow \bar{K}^{*0} e^+ \nu_e$	Ph.D.	UC-Santa Cruz	1993
2. E. Aitala	A-Dependence of D Hadroproduction	M.S.	Mississippi	1993
3. A. Santha	Study of Charmed Meson Decays	Ph.D.	Cincinnati	1994
4. C. Gobel	FCNC Search, $D^+ \rightarrow \pi^+ \mu^+ \mu^-$	M.S.	Pontificia-Rio	1994
5. K. Podury	Production of Charmed Baryons	M.S.	Mississippi	1994
6. J. Wiener	Doubly Cabibbo-Suppressed $D^+ \rightarrow K^+ \pi^- \pi^+$	Ph.D.	Princeton	1994
7. L. Perera	Study of $D^0 \rightarrow K^- K^+ \pi^- \pi^+$	Ph.D.	Cincinnati	1995
8. K. C. Peng	Charged Two Body $D^0$ Decays	Ph.D.	IIT-Chicago	1995
9. P. Medina	Transverse Polarization of the $\Lambda^0$	M.S.	Mexico-IPN	1995
10. N. Witchey	FCNC Search, $D^+ \rightarrow \pi^+ \mu^+ \mu^-$ and $\pi^+ e^+ e^-$	Ph.D.	Ohio State	1996
11. J. Leslie	Hadroproduction of Charm Meson Pairs	Ph.D.	UC-Santa Cruz	1996
12. P. Kasper	Orbitally Excited Charm-Strange Mesons	Ph.D.	IIT-Chicago	1996
13. E. Cuaule	Production of Heavy Baryons	M.S.	Puebla-Mexico	1996
14. A. Tripathi	Semileptonic $D^0$ - $\bar{D}^0$ Mixing Search	Ph.D.	Ohio State	1997
15. Q. Jie	Observation of $D^0 \rightarrow K^- \pi^+ \pi^0$	M.S.	Mississippi	1997
16. H. Carvalho	Measurement of $D^+ \rightarrow K^- K^+ K^+$	Ph.D.	CBPF-Rio	1997
17. A. Manacero	Performance of Parallel Programs	Ph.D.	Campinas U.	1997
18. G. Hurvits	Pentaquark Search via $P_{\pi^0}^0 \rightarrow K^+ K p$	Ph.D.	Tel Aviv	1997
19. K. Stenson	Total and Differential $D^0$ Cross Sections	Ph.D.	UW-Madison	1998
20. R. Zaliznyak	Form Factors in Semileptonic D Decays	Ph.D.	Stanford	1998
21. D. Mihalcea	Form-Factor Ratios for $D^+ \rightarrow \bar{K}^{*0} \ell^+ \nu_\ell$	Ph.D.	Kansas State	1998
22. S. Yang	Form-Factor Ratios for $D_s^+ \rightarrow \phi \ell^+ \nu_\ell$	Ph.D.	Kansas State	1998
23. S. Maytal Beck	Pentaquark Search via $P_{\pi^0}^0 \rightarrow \phi \pi p$	Ph.D.	Tel Aviv	1998
24. J. Solano	Production Asymmetry of $\Lambda^0$ , $\Xi^-$ , and $\Omega^-$	Ph.D.	CBPF-Rio	1998
25. G. Fox	Multidimensional Resonance $\Lambda_c^+ \rightarrow p K^+ \pi^-$	Ph.D.	S. Carolina	1999
26. S. Radeztsky	Dalitz Analysis of $D_s^+ \rightarrow \pi^+ \pi^+ \pi^-$	Ph.D.	UW-Madison	1999
27. C. Gobel	Non-Resonant 3-Body Hadronic D Decays	Ph.D.	CBPF-Rio	1999
28. A. Massafferri	$D \rightarrow 3\pi$ Dalitz Analysis	M.S.	CBPF-Rio	1999
29. R. Weiss-Babai	Pion Light-Cone Wave Function	Ph.D.	Tel Aviv	2000
30. S. Devmal	Study of the Decay $D^0 \rightarrow K^- K^- K^+ \pi^+$	Ph.D.	Cincinnati	2000
31. D. Langs	$D^{*\pm}$ Differential Cross Sections, Spin...	Ph.D.	S. Carolina	soon
32. E. Aitala	Search for Rare $D^0 \rightarrow V \ell^+ \ell^-$ Decays	Ph.D.	Mississippi	soon

# Prognosis for continuing degree awards

- Two more Ph.D.'s are expected:
  - Eric Aitala
  - David Langs

# Needs from Fermilab

- Phone, office for visitors such as Arturo Fernandez.
- Jeff Appel's time and effort
- Simon Kwan, Jean Slaughter and Ray Stefanski are still involved in supervising ongoing work.



# Availability of data to others

- Most recently, data have been available to students joining late and they have been made co-authors of E791 publications.
- We are eager to have more results based on our data and are interested in further such collaboration.

# E791 Summary

- E791 was the culmination of a long series of charm experiments at TPL.
- Historically, we
  - Proved capability of Silicon in heavy flavors
  - Two-magnet spectrometer
  - Massively parallel DA architecture
  - 8mm tape technology
  - Parallel computing farms
  - Open trigger experiment
  - Massive data taking opened new physics.
- Many first time analyses, even late, despite funding pressures.